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Effect on Efficiency of Air Filter Element at Steady and Dynamic Condition

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Abstract: ***For the better protection of the engine, required highly efficient air. Primary feature of engine air filter element is the dust holding capacity, in the parameters major factor is efficiency when we are selecting an engine air filter media or element. For deliver higher filtration performances constantly being challenge in automotive engine air filters. There is need to protect the engine from dust particle which effects on the performance and life of the engine, abrasive contaminants are increasing to achieve longer engine life, for improved engine performance. The innovative air filter designs are required to maximize filtration property and better performance. The performance of the engine as well as life of the engine are based on filtration efficiency of air filter. In this study we are discussed about filtration efficiency of the air filter. In this experiment we study the effect of the vibration on the air filter media performance as compare with the steady performance of the air filter media or assembly at steady condition. One is at steady condition and second is dynamic condition. Both tests are performing in the laboratory according to ISO5011 standard.***
Keywords: Air Filter, Filtration, Performance, Vibration, Air Filter Media.

I. INTRODUCTION

Working of the air filter assembly is supply the filtered air to engine which protect the engine, increase life of engine and filtration performance, also protect the engine. Basically, Paper filter media is used in the automobile segment for high performance of vehicle. In some 2w bikes and scooters foam is used as filter media. filter designs are super-saturated with the viscous oils to improve their filtration performance.

Most of the aftermarket foam filters are exhibit high oil migration, contamination with downstream sensors, and contamination of the functional parts, poor service and poor protection of the engine. However, the successful use of OEM foam filters for engine intake. This paper describes that the effect of the vibration on the air filter media as compare with the performance of the steady air filter media or assembly.

Almost all other theories of filtration are developed for flat media which placed in different direction or with the different shape to the required air flow direction. These theories have resulted the media in pleated formation gives high dust holding and filtration efficiency. In the most of air cleaner element the filter placement is vertically.

Now a days it's very challenging to increase the filtration capacity of the air filter media. Three major parameters required to control in air filter to increase the performance of the engine and life cycle of the engine. First is pressure restriction of the air filter assembly. Second is the dust loading capacity of the air filter and third and most important is filtration efficiency of the air filter or media used to filter the air. In heady vehicles or for bigger engines primary and secondary filter are used for increasing dust loading capacity and the efficiency for better performance.

II. METHODOLOGY

In this experiment two different type of test condition for air filter performance test one is steady condition, and another is dynamic condition. Required Air filter performance test rig for the experiment of Air cleaner assembly, in the testing we are compare the Pressure Restriction (ΔPr) of the air cleaner assembly in both the cases with various flow rates (m^3/min), another test is air filter performance test this test for dust loading capacity and filtration efficiency of air filter element.

Two-wheeler vehicles having small air filter and required less pressure drop and minimum flow rate as compare with other automotive or heavy-duty vehicles, we are test small assembly with the reference of that standard of two-wheeler air cleaner assembly, which is single stage air cleaner, not necessary to attached pre- cleaner or more filter element. Measurement the pressure restriction at 50%, 100%, & 150% of the nominal flow rate. The dust feed rate is less than 5g/min for two wheelers so light duty injector was used for testing. Dust concentration Based on the test flow, calculate the test dust feed rate using a dust concentration

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A. Test Setup

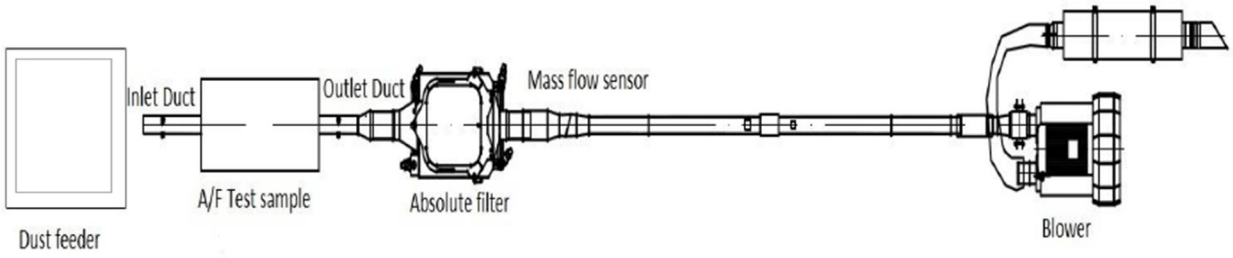


Fig.1 Air filter test rig.

In fig.1 the construction of air filter performance test machine setup (Wire Diagram). As shown in fig.1. Dust feeder is required to feed the dust into air filter assembly for the inlet of the air filter. Outlet of the air filter assembly is connected to the absolute filter. Between air filter assembly and absolute filter pressure sensor are connected to measure the pressure. Absoluter filter is connected to the blower with mass flow sensors to adjust the flow rate. This test setup is for steady condition. For dynamic condition vibration shaker bed is connected or placed below the air filter assembly, to generate the vibrations.

B. CAD Model

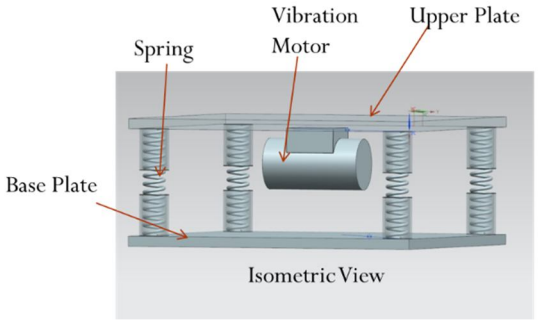


Fig.2 CAD model for vibration fixture Bed

C. Input Parameters

Experiment is conducted in laboratory for both steady and dynamic condition the parameters set for testing are same for both conditions, the flow rate is 0.37m3/min for pressure restriction test. Flow rate for performance test is same and concentration of dust loading is 2.7g/m3 at constant flow rate. This parameters for steady condition test. For dynamic condition test input is given to the vibration shaker bed is 70Hz as shown in fig.3

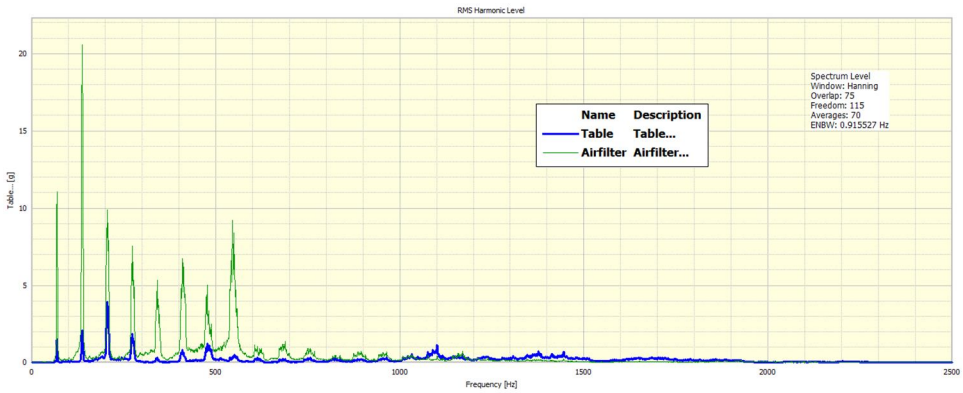


Fig.3 Results from Vibration bed and Air filter assembly

III. RESULTS AND DISCUSSION

The results of Pressure Restriction Test for steady and dynamic condition are shown in Table 1. There is no difference at steady and dynamic condition fo 100% flow rate the results are 109.2Pa and 110.4 Pa.

Table 1. Comparison of Pressure Restriction Test

Flow Rate	Steady Condition	Dynamic Condition
% Of Nominal	Pa	Pa
50%	35.6	35.7
100%	109.2	110.4
150%	227.8	227.9

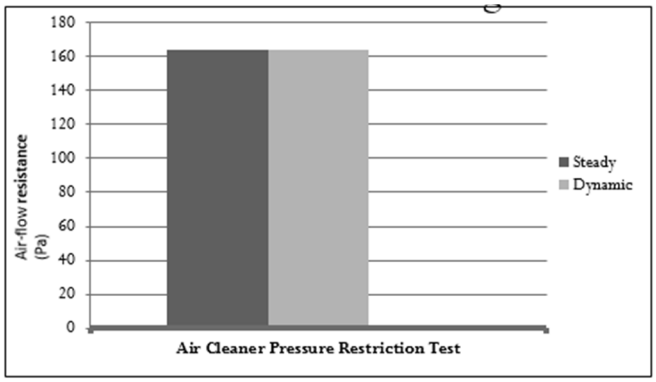


Fig.4: Pressure Restriction Vs Air Flow rate graph

In the air filter performance testing, there is no effect on filtration capacity of the air cleaner assembly. In the steady condition test the filtration efficiency of the filter media is 99.09% and the filtration efficiency in the dynamic the test condition is 99.11%.

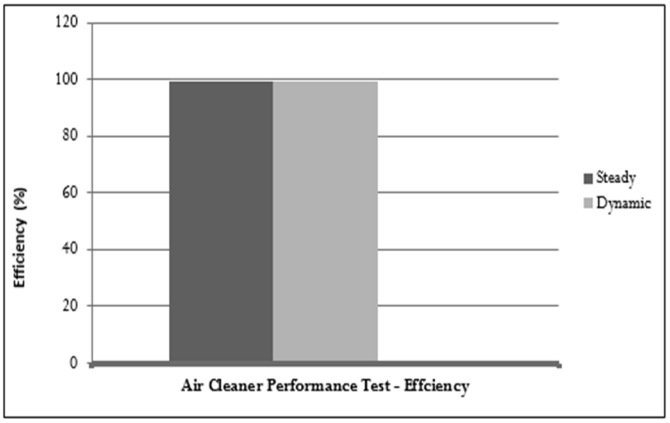


Fig.5: Efficiency of air filter element

IV. CONCLUSION

For the same air flow, both air filters at steady and dynamic condition generate similar pressure restriction. Similarly with increasing the flow rate pressure restriction also increases. Also, the filtration capacity of the air filter media is nearly same. From the above results and graph, there is minor change in dynamic condition of air filter assembly for pressure restriction and filtration efficiency. Efficiency gets increased.

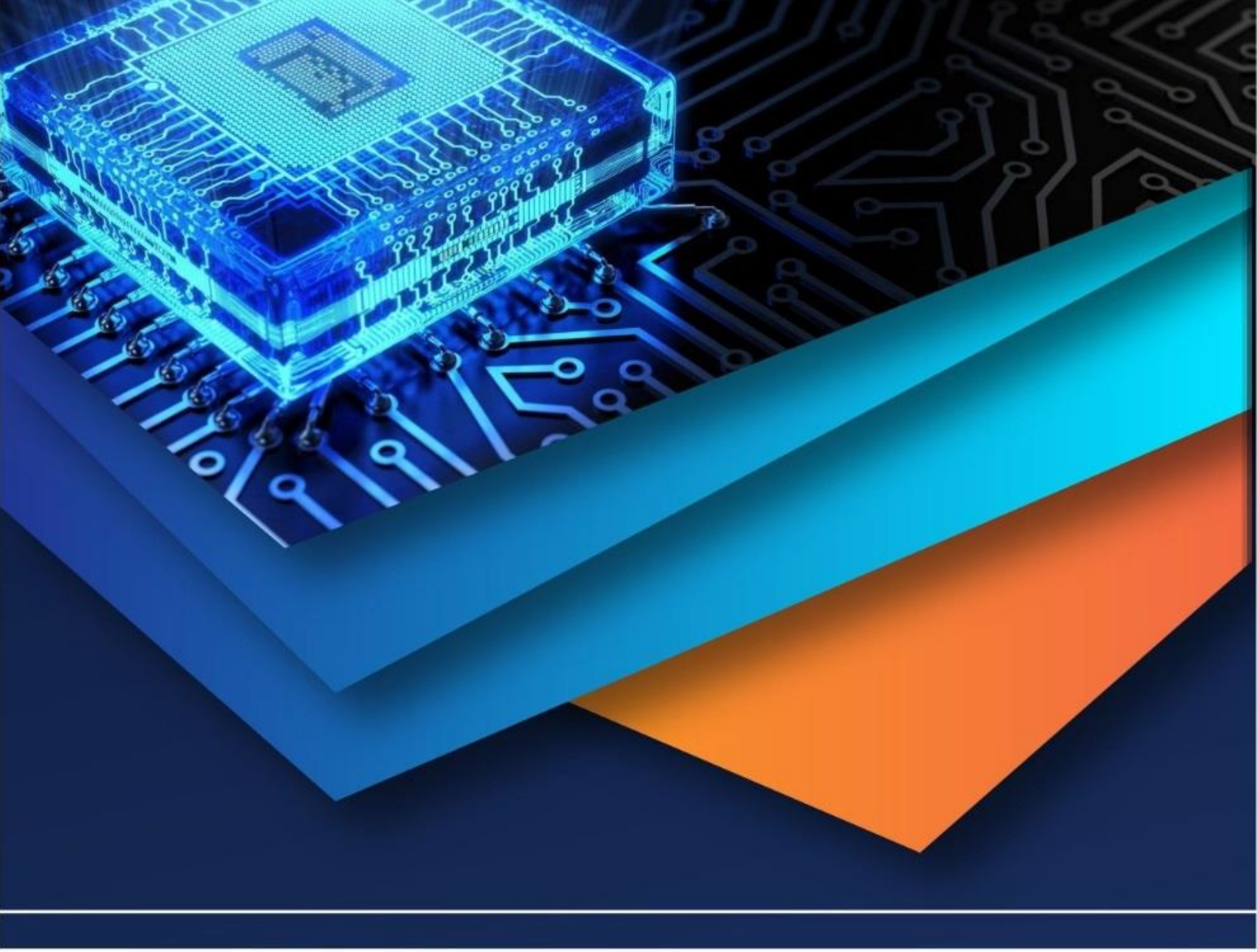
V. ACKNOWLEDGEMENTS

This Experiment is carried out with equipment available at Varroc Polymers Tech Center, R&D analytical laboratory.

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